Cost-Benefit Analysis and Ethics

Part 1: History and Basic Design

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Cost-Benefit Analysis and Ethics

Part I: History and Basic Design

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The purpose of this and the following chapter is threefold. Firstly, I will write a short history and present the basic assumptions of cost-benefit analysis. Secondly, I will present some of the basic features of cost-benefit analysis as a planning tool. Thirdly, I will bring special attention to some of the main ethical difficulties which one is inevitably faced with when using cost-benefit analysis as a planning tool.

Cost-benefit analysis (or, as it is usually called in the U.S.: benefit-cost analysis) is not an altogether unambiguous concept. To begin with one can distinguish between two kinds of cost-benefit analyses. On one hand, there is the specifically economic kind of analysis, which emerged together with microeconomics and neoclassical economics during the 19th century. In this case the value or significance of everything needs to be expressed in monetary terms and based on people's willingness to pay for it. On the other hand, there is a broader kind of analysis, which is not exclusively economic in this sense, but includes assessments with at least some descriptions of costs and benefits expressed in non-economic and qualitative terms.

In general, though, the term 'cost-benefit analysis' refers to the quantitative economic kind of analysis. Even then, however, it is necessary to distinguish between two approaches to the valuation procedure (Campen 1986, 26f). On one hand, there is the "conventional" approach which sees cost-benefit analysis as applied welfare economics with its standard valuation techniques. On the other hand, there is the "decision-making" approach, which holds that the actual decision-makers should influence evaluations related to key parameters like, for instance, risk and uncertainty, the relative weight attached to the

interests of different social groups, or non-economic elements like loss of human lives, irreversible environmental impacts, etc. The conventional approach, where the analyst takes on the role of a neutral expert who only relies on mainstream economic methods and principles like efficiency and maximization of economic benefits, is the most commonly used of the two.

Thirdly, one can distinguish between private and public cost-benefit analysis. In the first case the point of view is that of the private company or consumer, and only the company's or consumer's own interests are relevant. In public cost-benefit analysis, on the other hand, the point of view is that of the society at large, hence all interests become relevant. Public costs-benefit analyses can either take a local, national or global point of view depending on the issue that is being considered. In the first two cases only a specific group of interests are included, whereas the last kind takes account of all interests on an equal basis. Again, in general, the term 'cost-benefit analysis' refers to economic evaluations of public projects and policies, and more often than not from a national point of view where only the country's own citizens have standing (Boardman et.al. 1996, 43f).

Fourthly, it is necessary to distinguish between *ex ante* and *ex post* cost benefit analyses. Most cost-benefit analyses are completed before (*ex ante*) a decision is made about a certain project or policy. It can also be made afterwards (*ex post*), however, in order to make sure whether the decision was economically sound (or whether the previous *ex ante* analysis was reliable), or it can be revised continuously along with the execution of the decided project or policy (*in medias res*).

Basic assumptions in cost-benefit analysis

Cost-benefit analysis is a sub-department of welfare economics which again is a sub-department of ethics (Little 2002). Or, to be more precise: cost-benefit analysis is a tool that is designed to support ethical and political decision making by using a specific set of simplified assumptions.

Firstly, it is assumed in cost-benefit analysis, in accordance with its utilitarian origins, that the goal of society is to maximize private utility, which in turn may be equalled to maximizing pleasure and minimizing pain (for a further analysis of origins, see Arler 2005). This can be difficult to measure, however. Welfare economists, therefore, have reformulated the goal to maximize *preference satisfaction*, assuming that preference satisfaction causes pleasure. People's preferences are revealed through their willingness to pay

as consumers. The welfare of two persons can easily be compared, then, because the values of their satisfaction of preferences are commensurable and directly measurable by their willingness to pay for it.

Secondly, it is assumed that, in general, the market is the best allocator in terms of efficiency related to preference satisfaction. If the market is left to work on its own without public interference, a balance or equilibrium occurs automatically – a balance which can never be exceeded by human planning. Public interference should therefore only be considered in cases where the market for some reason fails to do a proper job.

The basic assumptions in cost-benefit analysis can be summarized in the following list of assertions:

- The common good or social utility can be reduced to an aggregation of the utilities of individuals. Society is conceived as the sum of individuals interacting to their mutual advantage.
- The complete utility related to an individual can be reduced to an aggregation of separable preference satisfactions, no matter how and why these may happen to be attained.
- In order to avoid double-counting, individual preferences are assumed to be related only to consequences for the individual him- or herself. They do not include political preferences for more equality in society, for instance, or preferences for other people's flourishing, unless this is reflected explicitly in the individuals' market behaviour. Even if the individual can be observed to be willing to pay for these goods, it is often assumed that what he or she is actually paying for is some kind of personal satisfaction such as the "warm glow" following from virtuous acts or peace of mind.
- The marginal utility of goods is diminishing. For each extra unit of a certain good one gets, less utility is obtained compared to the previous units (unless otherwise proven).
- In general, desires or preferences are revealed through individuals' behaviour on the market, and their intensities (together with their expected duration and certainty) can be measured by the consumers' willingness to pay.
- The market provides a balance or competitive equilibrium, where social utility is maximized, as long as no market failures occur.
- Consequently, public interference is only appropriate in cases of market failure.
- In these cases the aggregated costs and benefits of possible interferences should be measured through calculations based on *shadow pricing*, where ideal market processes are imitated as far as possible.

- Prospective projects and policies should be ranked in accordance with their benefit-cost ratio, and the one with the highest score should be implemented first. Implementation of the remaining projects and policies should be continued until the public budget is used up, or the one combination of projects and policies should be chosen which maximizes net benefits within the budgetary limits.

One of the most basic assumptions is that, due to the efficiency of the market, it is only in cases of market failure that public interference is needed for adjustment. This is done through the construction of theoretical markets, which as far as possible reflect the observed normal market behaviour of individuals. This is where cost-benefit calculations become relevant.

Cost-benefit analysis – a short history

Although the first study which may be called a cost-benefit analysis was carried out by the French Abbé de Saint Pierre, who studied the utility of public road improvements in details as early as in 1708, a more systematic treatment did not emerge until a group of French engineers at the *École Nationale des Ponts et Chaussées* made an effort to develop methodical procedures in the spirit of the Scottish philosopher Adam Smith and his French adherent Jean-Baptiste Say in the first half of the 19th century (Ekelund & Hébert 1999). These engineers saw the purpose of public works explicitly as one of redressing market failures, wherefore their utility needed to be analysed in market terms.

The culmination of this theoretical effort was a series of influential articles written by the French engineers Auguste Cournot and Jules Dupuit in mid 19th century. In these articles they developed a number of points which are often associated with the so-called founding fathers of micro-economics, who wrote their most influential books in the second half of the 19th century. Dupuit, in particular, is recognized as the inventor of the so-called *marginal utility analysis*, where the value of a project is measured by the consumers' willingness to pay for marginal benefits in a situation, which is assumed to be close to a competitive equilibrium (Dupuit 1844/1952).

Despite the efforts of the French engineers and a few other early attempts cost-benefit analysis in the spirit of neoclassical economics was not systematically applied until 1936, where the U.S. Flood Control Act required that the expected benefits from planned flood-control projects should exceed their presumed costs (Campen 1986; Hufsmith 2000). This act was part of

the New Deal anti-depression program of President Franklin D. Roosevelt focusing on the creation of new jobs and giving new stimulation to the economy after the great Wall Street collapse. The Flood Control Act was the main result of a process where new planning instruments were introduced by the National Planning Board which was established in 1934, and the issue of flood control – or, more generally, management of water resources, including flood control, water supply, irrigation, navigation, hydropower, and later on: water-related outdoor recreation and water quality – became the spearhead of the introduction of cost-benefit analysis as part of public administration in the U.S.

In the following years various committees related to the public management of water resource continued to develop the principles and standards used in cost-benefit assessment. The most significant result of this process was the publishing of the report *Proposed Practices for Economic Analysis of River Basin Projects* by the Sub-Committee on Benefits and Costs of the Federal Inter-Agency River Basin Committee in 1950. This report, which soon became known as the Green Book, for a long time set the standard for the construction of cost-benefit analysis in relation to public investments (Hufsmith 2000, Caulfield 2000, Kneese 2000, Pearce 1998). It explicitly used some of the controversial principles developed in neoclassical welfare economics, particularly in relation to the accounting of secondary costs and benefits on a national scale ("*to whomsoever they may accrue*") and to discounting future costs and benefits based on opportunity costs of capital rates, i.e. the rates which could be obtained from the most beneficial alternative investments. It also triggered a heavy activity in developing cost-benefit analysis in various research institutions, of which the Harvard Water Program was the most influential. The Green Book was never fully adopted by the Federal Committee, however, due to disagreements about which secondary costs to include.

The basic principles and procedures recommended in the Green Book were adopted by the U.S. Bureau of the Budget in their *Budget Circular A-47* from 1952. This Circular was used by the Bureau on all water related projects during the 1950's, the peak period of dam building, although with a strong emphasis on primary regional benefits. Since then cost-benefit analysis has been a recurring feature in U.S public regulation, and from the early 1960's – when the Circular A-47 was replaced by the broader *Senate Document 97* (Caulfield 2000) – it was adopted in other public investment programs, and along with the growth of government spending during the 1960's it was applied in new areas like transportation, health, and safety regulations (Campen 1986, 20). In general, however, the programs were still designed from a multiple purpose approach, where objectives like expenditure constraints, equitable income distribution, regional development, human health

effects, and, only marginally, preservation of environmental quality were assessed along with that of economic efficiency. The programs did not try to measure these impacts in monetary terms, but considered them as 'incommensurables.'

This problem, particularly in relation to externalities, became a major issue of research in the *US Environmental Protection Agency (EPA)*, which president Richard Nixon established in 1970 (Pearce 1998, U.S. EPA 2003), and where various indirect "revealed preference" techniques were explored, despite the fact that cost-benefit analysis was prohibited in relation to some of the basic environmental laws – the Clean Air, Clean Water, and Endangered Species Acts – from the early 1970's (Cropper and Oakes 1992, 675; Arrow et.al. 1996, 4; Nash 1989). At that time cost-benefit analysis had obtained a rather nasty reputation due to a series of studies, which mainly served as mere window dressing for predetermined positions on some dubious water regulation projects. In 1976, a congressional sub-committee went as far as to conclude that cost-benefit analysis to a large extent was used as "*an effective disguise for subjective advocacy*" (Campen 1986, 52).

The EPA-research did help cost-benefit analysis getting a comeback as a primary tool in public regulation, particularly because health and environmental issues, hitherto largely ignored, were now included in the studies. Consumer valuations of externalities were inferred from property pricing in areas of high environmental quality, transportation costs to nature sites, etc. These techniques were, particularly in the 1980's, supplied by "stated preference" techniques like the so-called *contingent valuation* based on Willingness-To-Pay surveys. This technique had been suggested as early as in 1947 by the economist Ciriacy-Wantrup, but it was not generally recognized until a couple of EPA-conferences in the 1980's brought it into mainstream economics (Hanemann 1994). The methods were acknowledged officially in the U.S. in the 1980 *Comprehensive Environmental Response, Compensation and Liability Act*, which included recognition of rights to sue for damages on non-use values. This inclusion later on led to a heated debate on existence value and liability of contingent valuation, particularly after the Exxon Valdez accident in 1989 (Portney 1994).

The essential idea was to internalize the externalities into the cost-benefit planning method in order to be able to use a coherent evaluation scheme without 'incommensurables.' During the last three decades of the 20th century EPA funded more than 450 studies focusing on methods for economic analysis, particularly on measuring environmental costs and benefits (U.S. EPA 2004).

Cost-benefit analysis was officially recognized as a basic tool in U.S. federal planning when, in February 1981, president Reagan signed the *Executive Order 12291*, which required that federal regulatory agencies use cost-benefit analysis (as the basic part of the so-called *Regulatory Impact Analysis*, RIA) on proposed regulations which are estimated to cost more than $100 million. This was not all too radical a change, however, as previous presidents had already encouraged economic efficiency assessment of public investments, and although 'cost-benefit analysis' was not explicitly mentioned in president Jimmy Carter's *Executive Order 12044* from 1978 or in President Ford's *Executive Order 11281* from 1974, the weighting of economic gains and losses were nevertheless strongly recommended as part of what Ford called *Inflationary Impact Assessment* (later renamed to *Economic Impact Statement*) and Carter called *Regulatory Analysis* (RA) (Campen 1986, 20; U.S. EPA 2003). So it was in President Bill Clinton's *Executive Order 12866* on Regulatory Planning and Review from 1993 recommending *Economic Assessments* (EA), which through the Office of Management and Budget (OMB) still sets the standard for economic evaluations of public initiatives.

In the period following Reagan's Executive Order the focus was turned from public project investments to policies and regulatory actions, and the implicit aim was to prevent "over-regulation" (Pearce 1998, 87; Campen 1986, 54f). 'De-regulation´ and 'efficiency in public expenditure' became the new buzzwords, not only in the U.S., but in many other parts of the world as well. Cost-benefit analysis does not *a priori* recommend deregulation and privatization, however, even though the strong commitment to market mechanisms obviously pulls in this direction.

Core elements and principles

According to the neo-classical paradigm cost-benefit analysis should only be used in cases where public interference becomes relevant due to the presence of a market failure. Some of the most common cases are:

- When the market *cannot provide certain goods* without public planning and/or interference. This is primarily the case in relation to the basic infrastructure: transport systems, water supply systems, sewage systems, waste management systems, energy transport systems, research facilities, etc., and to their regulatory and institutional setting: energy policy, transport policy, agricultural policy, cleaner technology policy, etc.

- When public projects may *help the market getting started* again in cases of regression and unemployment (although not all welfare economists would accept interferences in this case).
- When the values of some costs or benefits, the so-called *externalities*, are not registered on the market. This is first and foremost the case with current and future environmental and health effects like the consequences of an enhanced greenhouse effect, loss of biodiversity and nature quality, eutrophication, toxic or eco-toxic chemicals, etc.

The essential idea of the method is to compare a scenario, which includes the realization of a promising project or policy (or the closing of a problematic project/policy), to a scenario without this project or policy and/or to scenarios with alternative projects or policies. The basic principle is that the one project or policy should be chosen, which leads to the scenario which scores best in economic terms. Present as well as future cost and benefits are estimated through so-called *shadow pricing*, i.e., the consumers' expected willingness-to-pay on the margin, assuming that the market is working close to its optimum (within certain unalterable constraints). In principle, all those projects or policies should be realized, which come out of the analysis with a positive score, and therefore *potentially* enhance the welfare of at least one individual without declining the welfare of others (who can, in principle, be compensated).

Projects and policies with a positive score thus pass the so-called *potential Pareto-improvement* test in accordance with the so-called *Kaldor/Hicks criterion*: a project or policy is an improvement, if, in principle, the gainers could compensate the losers even if they do not. It is only a *potential* improvement according to the Pareto criterion, because somebody is actually going to be worse off without compensation. It is generally accepted as the basic criterion in cost-benefit analysis, though, for pragmatic reasons – almost no project would comply with the strict Pareto criterion – assuming that in the end there will be a balance between gainers and losers of different projects and policies, or that everybody will gain from general economic improvements.

In the following paragraphs the typical steps of the analysis are presented. Apart from a few minor variations, the overall design of the procedure is generally accepted (cf. Campen 1986, U.S. EPA 1983/1991, OMB 1996, Layard & Glaister 1996, Boardman et.al. 1996, Finansministeriet (Danish Ministry of Finance) 1999, U.S. EPA 2000, Møller et al. 2000). What is much more controversial, however, is the choice of assumptions and methods used in each of the procedural steps as well as the range of impacts to include. I shall return to some of these controversial issues in the following chapter.

Step 1: Identify the problem (market failure) and seek promising solutions

According to the neoclassical economics paradigm, the standard problems, which justify public action, are market failures. The identification of a market failure and the justification for public action is therefore the first step in cost-benefit analysis. For example, although it seems reasonable to build a bridge across a river in order to save time, and many truck and car drivers can be expected to be willing to pay their tiny part of it, no private company may be ready to initiate the construction right away due to the high construction costs, the risks involved, existing public plans and regulations, etc. So the market cannot solve the problem without a certain amount of public involvement.

The next step is to find the most promising projects (or changes in public regulations) which could solve the problem at hand. In the case mentioned, building a bridge may seem the most obvious solution, but there may also be other ways to solve the truck and car drivers' inconveniences. More ferries, for example. The selected solutions can then be varied in many ways: time and scale, renting or purchasing, changing location, varying quality targets, etc. (cf. also U.K. Treasury 2000, 18). These are only the most obvious answers, however. More comprehensive kinds of planning policies – relocation of the local industries, for instance – may also help to solve the problem. In general, however, due to the neoclassical paradigm, these more comprehensive solutions are seldom tried, because they interfere more with the market mechanism, which is accepted as the most appropriate means to improve public welfare. The general assumption has typically been that *piecemeal engineering*, to use the Austrian philosopher Karl Popper's expression (Popper 1974), is always preferable to comprehensive planning.

With the move from project investment to policy and regulatory action as the main field for cost-benefit analysis, this has changed to some extent. Policies are always more comprehensive than projects. There are also usually more alternatives to choose amongst: improved information, command and control, performance-based standards, taxes, fees, charges, subsidies, marketable emission permit systems, deposit-refund systems, voluntary agreements, etc. The selection of alternatives depends not only on the nature of the issue at hand, but also on tradition, political signals, approach fashion, etc.

In many cases a solution has already been proposed by the public authorities, and cost-benefit analysis is then applied in order to determine whether the proposed policy or project is as worthwhile as it seems to the authorities proposing it. Consequently, the analysis only covers a fairly narrow range of projects and policies, in most cases only the proposed project or policy in

various designs. In theory, the proposed project's benefits should be compared with those of all other possible projects, even in other policy areas (health policy, for instance), in order to find the most beneficial ones. In practice, this is never done (Boardman et.al. 1996, 13). In any case, there is inevitably a balance to be observed between thoroughness of analysis and limits of practicality (OMB 1996, 4 and 7). It is worth remembering that cost-benefit analyses are very costly. A ten year old study showed that the US Environment Protection Agency on average spent $700.000 (1996 prices) on each analysis of proposed regulations which fulfilled the criteria in Reagan's Executive Order (Boardman et.al. 1996, 12).

Step 2: Define and delimit the impact analysis

Next step is to define and delimit the analysis. There are three important questions to answer in advance. The first question is how many aspects of the project, the life cycle of a bridge, for instance, should be included. The standard answer is that all significant impacts should be taken into account, but significance is not always a quality, which is easy to agree upon. It is not altogether obvious which impacts to include.

We are also faced with questions like how far away in time and space impacts should be taken into account. Building a bridge will have consequences in many links, where the precise causal relationships are often difficult to specify. The well-known example from Chaos Theory of an Amazonian butterfly causing a storm in China when circumstances are right illustrates the difficulties involved in specifying the causal chains in an environment evolving in nonlinear processes. Conclusions are necessarily preliminary, uncertain, and very often based on controversial scientific knowledge. It has to be decided, too, which geographic as well as time scales to use. In practise, due to limited amounts of time and resources, only a rather narrowly defined part of the consequences is typically described. If, in accordance with the piecemeal engineering approach, the project or policy is considered as a marginal change – as is most often the case – this will often tend to make cost-benefit analysts use of a narrow definition, too.

Secondly, before describing the impacts it is necessary to identify a *baseline scenario* against which the proposed policy or project should be evaluated. The specification of baseline conditions has significant influence on the final result. One possibility is simply to use status quo as baseline. Another is to pick the most likely scenario, if the policy or project is not carried through, based on relevant trends. In the previously mentioned bridge case, it can be estimated how traffic is likely to change over time, how the general economic state of affairs can be expected to alter, etc.

This kind of baseline scenario building is often burdened with huge uncertainties. Several highly unpredictable factors are often of crucial importance in long-term scenarios. Let me just mention a couple of examples. Firstly, assumptions about technological innovation with and without a proposed project or policy are difficult to handle due to the very nature of innovation. What makes it even more difficult to deal with is the fact that technological innovation is not exogenous to the implementation of the proposed project or policy, but often to a large extent dependent on this (Löschel 2002). Secondly, assumptions about long time future demand cannot be anything but shaky; this is particularly true for goods like scarce environmental resources.

In the *OMB* and *EPA Guidelines,* it is emphasized that the specification of baseline conditions is demanding on the "*honesty and integrity*" of the analyst, wherefore all assumptions should be clearly both identified and justified. The presence of components with great uncertainty and significant effect on the final results calls for the inclusion of more than one baseline in the analysis (U.S. EPA 2000, 21f; U.S. OMB, 9), but, again, this is seldom done.

The third important question to answer is whether a local, national or global approach is most appropriate. This is a question of whose interests are recognized to have *standing*: only those of local people, the national or global human interests, or the interests of all including those of other species. One possible answer in cost-benefit analysis is that willingness to pay is the key to getting one's interest into the account. This would not only exclude the interests of other species than humans, but also effects which are not recognized by the potential victims (a market failure in itself).

Another answer is that it is only necessary to include impacts on members of the political community who pays for the project. If the analysis is sponsored by a nation state, for instance, improvements of the trade balance of the country is counted on the positive side, even if this results in larger problems in other countries. Similarly, if only the net benefits of the paying local community is included, the costs of a project falling on neighbouring communities within the same country become irrelevant, unless these losses are covered through national taxation.

It is basically an ethical question to decide whose interests are recognized to have standing. The answer is not determined simply by the range of effects, but depends just as much on the understanding of the closeness of the relationships (human as well as inter-special) between the individuals affected by the impacts. To leave the decision to be determined by actual market behaviour is one possibility, of course. It is not a neutral one, however, but based on the rather precarious assumption that the market constitutes the best

decision procedure on ethical matters due to people's general lack of mutual interest.

Step 3: Describe the impact

The probable changes caused by the project or policy in question are described and measured in relevant units. In standard cost-benefit analyses it is paramount that all impacts are quantified either directly or by the use of indicators. Whenever possible, impacts should be described in ways which turn them into potentially marketable goods. Otherwise it is more difficult later on to attach precise economic values to them.

In order for impacts to be counted in the cost-benefit analysis, they need to have an impact on the preferences of human beings. Economists typically distinguish between different kinds of preferences. Some preferences are related to the direct or indirect *use value* of a good. Others are related to *option value*, i.e., the value of being able later on to use the good. This value is often determined as the expected future opportunities multiplied by some probability factor. Some economists estimate preferences related to so-called *bequest value*, i.e., the value (as experienced by current people) of leaving future generations, say, an area in good shape. This bequest value should not be mixed up with the actual value of a good (economically or otherwise) for future people. Finally, some preferences are related to *existence value*, i.e., the value (as experienced by current or future people) that something continues to exist even though it may have no present or future use value. Again, existence value should not be mixed up with *intrinsic value* (or inherent worth), i.e. the value or worth of entities which have their own good, independently of the value attached to them by human beings.

The inclusion of *risk*, i.e., the distribution of the probability of being hurt or injured by a project or policy, and *uncertainty*, i.e., the lack of precise knowledge about these (and other) probabilities, is a separate issue. In most cases, it is necessary to use average numbers as well as statistical probability estimates in relation to some of the costs and/or benefits of a project or policy. This is often a difficult task, because different scientists may have dissimilar opinions on the issue at hand, or clear evidence is lacking. Full disclosure and transparency is therefore important, and assessments of a number of plausible alternative scenarios, or a sensitivity test reflecting the differing interpretations of experts, are often highly needed. Delphi methods or consensus meetings involving groups of disagreeing scientists have also been used. Here, again, there is balance to be observed between thoroughness of analysis and limits of practicality. In accordance with cost-benefit analysis' focus on current consumer preferences, the actual consumers' risk

valuations should be of particular interest, but these are seldom included. Sometimes a risk premium for particularly risk-averse individuals is considered, though (U.S. OMB, 18).

Step 4: Attach economic values to the various kinds of impacts

In order to be able to compare the various kinds of costs and benefits directly, these should all as far as possible be *monetised*, i.e., economic values should be attached to all impacts of the selected alternatives. In most cases, it is essential that all goods are measured with a precise value, and not just as more or less compared with other goods on a common scale. Some values can be measured directly on the market: labour costs, building materials, land, equipment, office facilities, etc. – assuming, contrafactually, a) that the market works in accordance with the theoretical ideal, and b) that, in general, the measured impacts continues to have the same relative value.

Whenever there are obvious obstacles to this, like, for instance, the presence of monopolies, this should, in principle, be adjusted for in the analysis, but this is rarely done, and all the small market failures are simply ignored. Another problem, which is largely ignored, is the changing relative values of goods. This is particularly problematic in cases where long-term impacts are assessed, and even more so when future people's preferences – and the resulting market terns – need to be included.

Cost and benefits are considered as *opportunity costs*, i.e., the economic value of benefits forgone or gained when a public project or policy is carried through, including costs of compliance, administrative costs, transaction costs, and time losses. In cost-benefit analysis, public project should, in principle, always be measured against the best potential alternative, the benefits of which thus become the costs of the project (Layard & Glaister 1996, 1). The most straightforward way to measure these costs is to conceive of them as lost or gained *consumer* goods and – assuming the market to reflect the potential benefits of alternative applications – let opportunity costs equal the marginal costs as reflected in present prices on the materials, labour, property, etc. needed for a proposed project together with the losses and gains of consumer opportunities experienced by individuals directly or indirectly affected by the project.

Sometimes it is not as simple as this, though. For instance, if the market prices in an area can be expected to change significantly due to the implementation of the proposed project, i.e., when supply is *inelastic* to some extent, this will influence opportunity costs. If the market price of a good

becomes lower than a consumer would actually be willing to pay for it, measured by current market prices, there is, in accordance with neoclassical theory, a *consumer surplus*. Likewise, if the market price becomes higher than a producer would actually be willing to produce and sell a product for, there is a *producer surplus*. If a public project or policy changes the prices on certain goods, the positive or negative changes in consumer and producer surpluses are considered in the cost-benefit analysis. Lost or gained surpluses are accounted as positive or negative opportunity costs (the negative ones are sometimes referred to as *deadweight loss*), assuming that they would have been used or are going to be used or invested somewhere else.

Another way to measure the opportunity costs of a public project is to measure the lost or gained *investment* opportunities in general. In this case it is not the opportunity costs of the specific materials, labour, etc. but of lost or gained capital in a more generalized sense. These costs, the so-called *opportunity costs of capital* include the not achieved returns from potential investments, typically measured on the basis of market rates of return. There is no clear and commonly accepted rule telling when opportunity costs are measured as either lost consumer goods or lost investment opportunities. They are only directly substitutable, however, if one assumes a consumer's rate of time preference for consumption equal to the marginal rate of return of capital. Most cost benefit analyses treat opportunity costs as consumer costs and discount afterwards with a discount rate equal to the rate of return of investments (Arrow et.al. 1996, 130).

Externalities are – positive or negative – incremental impacts, which are not valued directly on the market. Examples of these are losses or savings of human lives, injuries and inconveniences, time losses or savings, increases or reductions of risks, losses of populations of certain species, impacts on nature quality, scenic views, losses or improvements of ecological services, inconveniences for other species, etc. In all these cases economic values are attached otherwise through various kinds of *shadow pricing*, assuming contrafactually the presence of an ideal market for non-priced goods.

This kind of shadow pricing can be done in a number of ways (cf., for instance, Cropper & Oates 1992; Pearce & Moran 1994, chp. 5; Pearce 1993, Appendix II; Hanemann 1994; Boardman et.al. 1996, chps. 10-12; U.S. EPA 2000, chp. 7). The general principle is that the measurement should be made in a way, which imitates the market mechanism as far as possible. For instance, non-prized goods like endangered species could be measured through so-called *contingent valuation* based on willingness-to-pay or willingness-to-accept surveys, where a representative group of citizens are asked, how much they would be willing to pay for saving the species, or how much compensation they would demand if the species eventual-

ly is lost. This is the *stated preference approach*, where individuals respond to hypothetical questions.

Some cost-benefit analysts consider this to be a rather unreliable way to make evaluations, though, and they prefer to use indicators based on actual market behaviour. This is the *revealed preference approach*. An example of this is the so-called *hedonic pricing*, where certain amenity values – peace and quiet, environmental quality, closeness to the sea, significant views, etc. – are reflected in property value. Other examples are valuation of time savings for various kinds of drivers based on their income related to the time saved, valuation of nature sites indicated from the travel costs people are willing to pay to reach the sites, or occupational-risk premiums in wages, indicating individuals' price for their willingness to accept incremental risks. Still another approach is to measure the expected costs of establishing alternatives to a lost good, the costs of cleaning an area after use, or the costs of re-establishing a lost good. This approach implicitly assumes that society (now or in the future) is willing to pay for the restoration.

The selection of methods depends not only on the matter at hand, but also on the chosen scheme for weighting the various interests. One basic dilemma is whether all interests should be taken into account on an equal basis, independently of ability to pay, or expected willingness to pay is a more proper measure. Most cost-benefit analysts tend to prefer the last solution, because it deviates less from what happens on real markets.

Step 5: Discount for time to find present values

All public projects and policies – building a bridge, for instance – have impacts for several generations. Actually, and this is a theme well known from science fiction literature dealing with time machines, any project will have irreversible consequences with long chains of impacts. In mainstream cost-benefit analysis, it is assumed that future costs and benefits should not count as much as current ones. They should be *discounted* or transformed to the so-called *net present value* by a *discount factor* $1/(1+r)^t$ where r is the *discount rate* and t is a time index (counting years from project start). In order to do this, it is necessary to set up a *time scheme* which shows when the various impacts are going to appear.

The main reasons given for discounting are that a) people are in general assumed to prefer to have current needs and wants satisfied rather than those they may have in the future, or b) technological improvement and economic growth in society is assumed to make people richer in the future, c) people are expected to care less and less about future people the further away they

are, because we know less and less about who they are and what they cherish, or d) future costs and benefits are more uncertain, because unforeseeable events may change the whole scheme. I shall return to discuss the validity of these arguments in the next chapter.

The choice of discount rate is extremely important in most assessments. In mainstream cost-benefit analysis it is often assumed that public investments displace private investments. Public investments should therefore do better in terms of interests than private investments; otherwise they should never be implemented. The right discount rate is accordingly believed to be the interest rate of the best or at least the average private investments, the so-called *private rate of return of investment*, reflected in the *market rate of return*, for instance, of long-term relatively risk-free bonds or of the average investments (both adjusted for inflation). This way one gets an estimate of the *opportunity cost of capital*, i.e., the before-tax rate of return to incremental private investments or, in other words, the missed opportunities for profiting from alternative investments. In this case the discount rate will typically be somewhere between 6 and 12 percent per year. It is a problem for cost benefit analysis, though, that there are several different market rates working at the same time due, for instance, to differences in risks (as perceived by the agents) in different areas.

It is necessary to distinguish between marginal, short-term projects and comprehensive long-term policies. In relation to long-term projects and policies which cannot be considered to be marginal, one could easily end up in a contradiction, if a high market rate of return is used, because this would inevitably influence the general *increase in per capita income* or *rate of growth of consumption* – with a corresponding decrease in the marginal utility of net benefits – both of which are usually assumed to be lower than the market rate, typically some 1 to 3 percent per year, although higher in periods of rapid growth and lower in periods of recession. It should be noticed that this rate varies from country to country and from time to time so that, in principle, different rates ought to be used. In practice, the same rate is generally used on all impacts.

Step 6: Add up costs and benefits

If all costs and benefits of alternative solutions are valued with the same denominator, the final aggregation is simple. One can simply pick up all the pieces, collect them, and see how profitable the various solutions are. Still, the aggregation can be made in a less straight-forward way, if it is assumed that one monetary unit of costs and benefits is not equally valuable to all. An alternative to the simple aggregation would be to give *asymmetrical weight*

to the anticipated costs and benefits of different groups. The U.K. *Treasury Green Book* even demands that any lack of explicit adjustment for distributional impacts needs to be justified by the appraising agency (U.K. Treasury 2000, 25).

A weighted account seems particularly appropriate in cases where the *potential Pareto-improvement* (or Kaldor/Hicks) criterion is used, but individuals living under difficult circumstances are likely to get hurt. This choice would be consistent with various well-known ethical principles such as, for instance, the classical hedonistic utilitarian *law of declining marginal utility* of money, according to which maximization of happiness (or of real utility) demands equitable distribution of wealth, as well as with John Rawls' *difference principle* (or *maximin principle*), according to which "*the higher expectations of those better situated are just if and only if they work as part of a scheme which improves the expectations of the least advantaged members of society*" (Rawls 1973, 75). Following the first of these principles, one could, for instance, weight net benefits of various groups of people inversely proportional to wealth or income. Following the second principle, one could, similarly, increase the weight of net benefits of people with possessions or income below a certain threshold.

Apart from all the obvious practical difficulties of finding a reasonable way of doing this, a disproportionately weighted aggregation entails what many economists would see as the disadvantage of diverging the assumptions away from those working on the real market. For this reason mainstream economists avoid it: the two goals of maximizing wealth ("efficiency") and of making the social distribution equitable ("equality") should be kept separate, and not be mixed up in the analysis. At least, they argue, weighted cost-benefit analysis should never be made without a standard analysis to compare with.

Behind this recommendation lurks the general assumption, inherited from Adam Smith, that the market works best without interference, and that unfortunate outcomes is adjusted in due course by the market itself; people who lose in one game are likely to win in another, if the wealth of society is kept at a maximum. It could also be argued, though, that cost-benefit analysis is just one out of several tools that support decision making and that tools works best when they are kept as clean as possible. It is up to the decision makers, then, to mix the tools in accordance with their own standards.

Step 7: Carry out sensitivity tests

Due to all the controversial and precarious elements included in cost-benefit analysis, it is necessary to provide sensitivity tests based on alternative assumptions in order to see if decisions related to any of these elements are crucial for the final result.

Whenever this is the case, it is necessary to highlight the controversy by presenting conclusions of calculations based on alternative solutions to controversial issues. The following list includes some of the typical controversial and uncertain issues.

- Losses of human lives, injuries and health problems. How should the value of *statistical lives* and *statistical injuries* be estimated? Should the statistical lives of various groups of people be valued differently?
- Can *value transfers* from other studies be used in cases where data are sparse? Are the situations comparable, or, if not: how can they be made more comparable?
- Losses of *non-human species* or populations and other non-marketed *environmental goods*. How should we estimate *indirect use value*, *option value*, *existence value*, and *bequest value*? Are all kinds of values covered by the analysis?
- *Discounting* future impacts. Which *discount rate(s)* should we choose? Should all impacts be discounted? At the same rate?
- Dealing with *risk and uncertainty*. Can *risks* be quantified in more than one way? Are *expert estimates* dissimilar? Are uncertainties significant?
- Questions of *standing*. *Whose interests* should be included? Are some of the non-represented interests significant?
- The question of *baseline*. Which *variable factors* and *probable changes* are included? Is there more than one reasonable estimate of social and technological development? How are *future markets* going to look like, and how can this be accounted for in the analysis?
- The *alternative scenarios*. Which ones are chosen and what is included?
- The *theoretical framework*. Do different *economic theories* assume different causal relationships?
- The question of *equity*. How should the *distributive impact* be dealt with? How would different assumptions influence the result?

If cost-benefit analysis shall be of any help in ethical and political decision making, it ought to highlight all controversial assumptions and present some thorough reflections on the impact of alternative assumptions. Otherwise cost-benefit analysis becomes totally unreliable and worthy of the bad reputation it acquired in the seventies (and still has). It is true, of course, that there is balance to be observed between thoroughness and practicality, but

the sensitivity tests are the worst area to place savings, if a cost-benefit analysis should be worth the money.

Step 8: Compare the outcomes and rank them

Projects and policies with potential benefits, i.e., where the expected net present value is positive, should be ranked in accordance with their benefit-cost ratio. The one with the highest ratio should be implemented. In principle, implementation of all projects and policies with positive score should be continued until the public budget is used up (or the best mix of projects within the budgetary limits should be chosen).

In most cases it not as simple as this, however. Many costs and benefits are difficult to monetise in an unambiguous way, and in order to provide a reasonable foundation for political decision making it is necessary to present a number of impacts in a non-monetised way. This can be done, for instance, by the use of tables, where the importance of various hard to monetise impacts is estimated on, say, a scale from 1 to 5, and the estimates are defended by arguments. The use of procedures like this violates some of the basic principles in mainstream cost-benefit analysis – the monetisation demand, reliance on consumer preferences, etc. – but it makes the final outcome more trustworthy as well as more useful. The hard to deal with issues are not hidden behind controversial methodological decisions.

In practice, the ranking of projects and policies seldom follows the recommendations of mainstream cost-benefit analysis, but includes various other kinds of considerations such as distributive effects and matters of equity, enforcement and compliance problems, incentives for innovation, regional development, strategic importance, consistency with national and international legislation, etc. (cf. also U.K. Treasury 2000, 9f). I shall return to this at the end of next chapter.